DEVELOPMENT OF THE TROPICAL HOUSE

Architecture in North Queensland

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Since the end of the Second World War there has been an increasing national awareness of the urgent need to develop and defend our North which has coincided with the discovery and exploitation of more vast mineral deposits, the construction of huge water storage and irrigation projects and bold developments in primary production.

This continuing expansion has created many more opportunities for employment and several new towns have been, or are in the process of being built to attract and serve the new citizens of our under-populated North.

SUITABLE BUILDING DESIGNS

The construction industries have been under heavy demand, and the valuable post-war work of the universities and building research organizations is showing its influence on the emergence of regionally suitable building designs for the local climates, whether they be for habitation or commerce or industry.

There were three reasons why an architectural vernacular has been slow in development in the North. Firstly, the Anglo-Saxon pioneers, who when laying the foundations for such cities as Townsville—already the largest, healthiest and most successful white settlement in the world's tropics—had no established indigenous style of architecture resulting from the hard school of experience, and so the bush carpenters built in the only way they knew.

Secondly, economic influences were strong. With the exception of some ambitious civic and hotel building at the beginning of this century, cheapness was the criterion. Those residents of the north who regarded themselves as temporary exiles rather than permanent inhabitants, feared being unable to recover their expenditure on their houses when returning to the southern cities.

Thirdly, when major civic and commercial buildings were

required, the designers were invariably commissioned from Southern capitals with the result that their buildings varied little if at all, from those in their home towns. Unfortunately, this tendency continues to-day, as head offices frequently commission architects from other States or countries to design northern projects; so local climatic conditions are often imagined, rather than understood.

THE CLIMATIC ZONES

In order to appreciate the local knowledge required by a designer if he is to produce rational architecture for the locality involved, Australia's North can be classified into five climatic zones, which are characterized as follows:

1. *Hot Arid*: Hot dusty days, freezing clear nights, low humidity.
2. *Arid Tropical*: Hot dusty winters, clear cold nights and some summer humidity.
3. *Semi-Tropical*: Warm dry winters, hot humid summers, small daily temperature variation.
4. *Wet Tropical*: Pleasant winters, hot humid days and nights in summer, wet summer.
5. *Highland Tropical*: Medium day temperatures, cool nights, high rainfall.

Thus, the inland areas demand buildings which will provide suitable living conditions in a continental type climate, too hot for comfort in summer and too cold for comfort in winter. Few realise that, every January, the hottest place on the surface of the earth may well be found in that strip of country extending from the west of the Great Dividing Range through Mount Isa to Marble Bar in the west. Yet the same areas can be unbearably cold at night!

THE DESIGN FACTORS

The principal design factors which govern the suitability of buildings for the tropics or sub-tropics, from the point of view of their effect on the occupants, are primarily those which affect the temperature, humidity and rate of movement of the air, and the radiation of heat to and from the bodies of the occupants. In general, for tropical conditions, the designer should place equal importance on a high rate of air movement around the occupants and protection from excessive radiant heat. In addition to these two basic objectives, the need of fully utilising the bright daylight available throughout the year, yet adequately controlling the glare and heat arising from the penetration of direct sunlight into the building makes a fundamental trio.

The main characteristics of the climate prevailing in the coastal areas of Queensland are relatively high temperatures with high humidity throughout the greater part of the year, which may be made tolerable by the prevailing cooling winds. (In Brisbane at 9 a.m. in the Summer months, 72% of days are over an effective temperature of 72° Fahrenheit). Although air temperatures are not abnormally high, as compared with the dry, arid areas of Australia, the radiant heat from direct sunlight and re-radiation from the heated surfaces of buildings (roofs, walls, pavements, etc) can be a serious problem. Therefore, the three essential objectives in designing buildings for habitation in this climate should be:

1. To provide the highest possible rate of air movement around the bodies of the occupants in hot weather. Since, in many cases, it would be uneconomical to provide mechanical means of promoting air movement, special measures must be taken in the building design to obtain the benefit of cooling breezes. An important aspect is the control of ventilation openings so that they may be closed in cold weather, during cyclonic storms or periods when the wind is strong enough to cause discomfort or dislodge papers, etc.
2. To protect the occupants from excessive heat: whether that re-radiated from parts of the building which have become heated by the sun, or from the effects of direct sunshine through wall or roof openings.
3. To employ special techniques to reduce radiation from the building shell and for shading windows or other openings. When providing adequate screening to sun-exposed windows, it may be necessary to increase the glass area to offset the resulting loss of natural light.

"HIGH STUMP" HOUSES

The early Colonial traditions of building were adapted with one major concession to regional conditions, that is the "typical" Queensland house elevated on high "stumps". This design, used throughout the State, has spread to the Northern Territory and New Guinea. It causes so much comment from tourists that the very logical influences which produced it are worth examination.

The early settlements of Queensland took place on the coastal river flats where there was usually an abundance of excellent building timbers from farmland clearing and

nearby forests. In these localities, the settlers had to contend with three problems—seasonal flooding, mosquitoes and white ants. The creosoted hardwood stumps raised their houses above the level of flood waters, breezes impeded by undergrowth, low-flying insects, and enabled easy inspection for white ant infestation. The sub-floor space provided protection for farm machinery, vehicles and produce.

Local timber roof shingles were used in some early buildings, but the majority were roofed with corrugated iron which caused the temperature to rise 40° to 50° Fah. in the roof space, the radiation from which drove the inhabitants to the cooler sub-floor area. The internal walls were generally one inch thick pine boards. The encircling verandah did not produce much relief as believed, because, although it shaded the walls, it caused the interiors to be both dark and ill-ventilated.

Both in Queensland and the Northern Territory, the principle of the elevated house remains the most popular. After World War II, a survey of housewives along the tropic coast revealed that 75% preferred "high stump" houses. They gave some fifty reasons, many of which were imaginary, but the basic reasons remain valid. It is sometimes modified as "split-level" with raised bedrooms only, which gives the housewife some alleviation from mounting flights of steps during her working day, yet has the added advantage of producing sufficient cheap space for garaging, storage, children's play space and clothes drying in the "wet".

Northern residents no longer need be embarrassed when their visitors ridicule the odd "stilted" houses, because the post-war research and development produced a regional domestic architecture of design and construction superior to that of the other States, which combines the best features of the pioneers' homes and the later raised homes.

The floor is a reinforced concrete "mat slab", the walls and ceiling are sandwich panels formed of polystyrene between plywood sheathing, and the roof low-pitched copper clad stressed skin plywood. Certain copper panels in the roof are solar collectors for water heating.

An interesting factor in the roof construction is that the designers have exploited the "Parasol" roof of the early outback tent houses and fettlers' cottages, to facilitate maximum cross ventilation between roof and ceiling.

Within this house it is intended that further experimental work will be done on the physiological and mental effects on people living under cool conditions in a hot environment.

EXPERIMENTAL HOUSING

Recent investigations into more suitable buildings for our tropical areas have been undertaken by the "Solar Energy and Tropical Housing Research Committee", which comprised members from the Architectural, Engineering, Physiology and Psychology departments of the University of Queensland, working with representatives from related industries. Their significant exploitation of solar energy, which has already stimulated the greater use of solar water heating in country areas, has extended into using it for air-conditioning purposes also. An experimental house was built to the Committee's design at the University's farm on the outskirts of Brisbane to test the results of their research.

The materials and techniques used in the construction of this house, although unusual by present standards, will eventually supersede conventional construction, particularly in remote areas where high costs of labour and freights must stimulate an increasing use of prefabrication combining light weight materials and panel "system" building methods.

COMMERCIAL BUILDINGS

When designing a factory or office building to provide the most comfortable working conditions, the architect's problem is to produce the best design, from climatic considerations, within the maximum cost figure stipulated by his client. In order to make a rational approach to this problem, he will require factual data on:

1. The performance, in terms of interior thermal conditions, of buildings of the various types, aspects and plan forms which are customary in the area concerned.
2. Special measures that might be taken to improve the thermal performance of buildings of orthodox design and construction, and the improvement in interior thermal conditions to be derived from them.
3. New forms of design or construction and new materials (and designs or materials not customarily used in the area) which appear to have advantages for hot climates, and the thermal performance of buildings so designed or constructed.
4. The evaluation, in terms of human comfort, of the foregoing thermal performance data.
5. The relative costs of different forms of design and construction, and the cost of special measures to enhance thermal performance.

Before the assessment of human comfort relative to thermal performances can be resolved, much physiological

research has yet to be done. It is the function of the building research organisations to provide, in a suitable form, objective data on the remainder.

CONSERVATISM OF BUILDING INDUSTRY

The technical data resulting from Government research into suitable buildings for the tropical and hot arid areas of Australia, is so readily available that "rule of thumb" or empirical methods should be disappearing. That they are not, demonstrates the essential conservatism of the building industry. The limited training—often father to son—of most small builders means that new developments in materials and techniques are slow in acceptance, whilst the building owner and his financier are both disinclined to depart from conventional construction. Moreover, the archaic building by-laws of most local authorities do not assist progress. The architect, specifying construction designed to reduce building and maintenance costs, freight and erection time, invariably receives higher tenders reflecting the building industry's unfamiliarity and caution. This paradox is easier understood when it is realised that the north, apart from its basic building materials, has to rely on uncertain deliveries of southern manufactured products.

In the new mining towns, this is being offset by the use of lightweight prefabricated buildings or "no-fines" concrete.

MICRO-CLIMATOLOGY

When attempting to establish architectural techniques most suited for a tropical environment, it is important that the designer acquaints himself of the *Micro-climate* of the building site. This implies that, although the climate of the locality may generally conform, there will be areas within it affected by typography, the proximity of large sheets of water or timbered area, and even the structure and cover of the ground. These variations due to the local micro-climate can be controlled by correct siting, designing and landscaping. This must result in economics in such elements of the building costs as heating, cooling and lighting.

A study of the world's history over the last 5000 years reveals that the mainspring of our civilization has been from the hot-arid zones surrounding the Mediterranean. The Middle-East environment has much in common with the Australian hinterland. The regional architecture of these civilizations reflects modifications evolved by human ingenuity to provide comfortable living conditions.

In these areas the buildings should be protected from hot winds, dust storms and ground glare but greater use of walled gardens and courtyards in which pools, trees, and moist vegetation can produce a more amenable micro-climate in a harsh environment.

THE IDEAL HOUSE

The ideal house in this climatic zone should comprise narrow wings, each for a clearly defined purpose, surrounding a central patio for maximum cross-ventilation. The day living rooms should have thick wall construction slow to heat and in the sleeping areas, lightly framed walls, which would be quickly cooling after sundown and soon warmed on cold mornings. Control of sunlight penetration must start outside the building. Although much information is available on pise or adobe construction, these very suitable and easily won materials have been little exploited in our inland areas.

One of the cheapest methods of reflecting sunshine is the use of white external surfaces. This has been understood for centuries in Eastern and Central American countries. As early as 1889, a Canadian journalist visited North Queensland and reported how pleasing it was "to see the banks and public buildings of Townsville built in refreshing white, with colonaddes and arcades, and looking like places for human beings in a hot climate, and not like gaols for lost spirits". Although even white roof tiles are now available, there has been slow public acceptance in our hot climates.

MECHANICAL COOLING SYSTEMS

It can be argued that some form of mechanical air-conditioning offers the most suitable working and living environment for the residents of the Tropics. But we must have cheaper power and lower installation and equipment costs before it can be in general use.

However, it is a lot less expensive to air-condition a building that helps cool itself. To-day even the air-conditioning engineer looks to the ancient devices of shaded walls and courtyards, light coloured surfaces left blank when facing hot exposures and screened openings to supplement his artificially-created climate.